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Are Forfeitures of Olympic Medals Predictable? – A Test of the Efficiency of the International Anti-Doping System

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Abstract

Modeling national Olympic medal counts has received much attention in recent research. National Olympic medal counts, however, may change after the event as a result of the fight against doping. We show for the Olympic Games that took place in Beijing 2008 that ex-post forfeitures of Olympic medals are predictable, at the aggregate level, using standard variables commonly used in earlier research to model national Olympic medal counts. The predictability of forfeitures of Olympic medal casts doubts that the international anti-doping system works efficiently

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1. Introduction

Much research has been done in recent years to identify variables that help to predict national Olympic medal counts (e.g., Bernhard and Busse 2004). Variables like GDP per capita, measures of population size, and past medal counts feature prominent in this research. Olympic medal counts, however, may change after the event as a result of positive doping tests.[1] We show for the Olympic summer games that took place in Beijing 2008 that standard variables widely studied in earlier research as determinants of national Olympic medal counts have explanatory power at the aggregate level for ex-post forfeitures of Olympic medals. In other words, such "data revisions" are predictable by using the same determinants that explain medal success, indicating that either the sporting success of different nations is influenced by the same determinants as doping or different national sport systems organize doping in a comparable way. Importantly, given that the predictors of ex-post forfeitures of Olympic medals were known at the time when the Olympic Games took place, the predictability of medal forfeitures can be interpreted to indicate that, at the institutional level, the international anti-doping system does not work efficiently. If the institutions of the anti-doping system would work efficiently, it should not be possible to predict later forfeitures of Olympic medals by means of variables known before or at the time the Olympics take place. Our test of the efficiency of the international anti-doping system is similar in spirit to tests of the rationality of preliminary announcements of macroeconomic data well-known in macro research (Mankiw et al. 1984).

2. Data and Empirical Results

Since the 2004 Olympic Games the International Olympic Committee (IOC) has stored samples for further doping analysis, implying that Olympic medals can be deprived many years after the games (cf. also Olympic Agenda). We studied data for the Beijing 2008 Summer Olympic Games because until now most cases of medal forfeitures refer to the 2008 Olympics.[2] Table I gives summary statistics of medal depreviations. While 204 countries participated in the 2008 Summer Olympic Games, athletes of only 86 countries won at least one Olympic medal (gold, silver, or bronze). In the case of 17 countries, an ex-post forfeiture of at least one medal occurred, where the minimum (maximum) of medal forfeitures per country is 1 (11). The mean (median) value of medal forfeitures, given that a forfeiture of an Olympic medal actually occurred, is 2.5 medals (1).

Table I: Summary Statistics of Medal Depreviations (2008 Olympic Games)

Statistic	Value
Total number of countries that won medals	86
Number of countries with medal depreviations	17
Conditional mean of medal depreviations	2.5
Conditional median of medal depreviations	1
Minimum of number of medal depreviations	1
Maximum of number of medal depreviations	11

In order to model medal forfeitures, we used explanatory variables that are standard in the literature on the determinants of national Olympic medal counts: GDP per capita, population size, lagged medal counts, and a dummy for former communist countries (Bernhard and

[1] Estimates of the prevalence of doping are commonly based on positive doping test results, on questionnaire studies of self-reported doping, and of doping by other athletes, and indirect questionnaires using techniques for the study of sensitive questions (Pitsch and Emrich 2012).

[2] See https://www.olympic.org/news/ioc-sanctions-16-athletes-for-failing-anti-doping-tests-at-beijing-2008. http://www.zeit.de/sport/2016-08/doping-medaillen-olympia. Press reports regarding forfeitures of Olympic medals after the Beijing Olympic Games are available from the authors upon request.

Busse 2004, Forrest et al. 2010, Buts et al. 2011, among others).[3] As is standard in this literature, population size and GDP per capita refer to 2004 to account for "time-to-build" considerations. We also considered the number of members of the 2008 Olympic team as an explanatory variable. Finally, we included the corruption perception index in our list of explanatory variables (see, for example, Pierdzioch and Emrich 2013).

Table II: Estimation Results

Model number	(1)	(2)	(3)	(4)	(5)	-6
Model type	Tobit model			Negative-binomial model		
Medal counts 2004	0.229** (2.92)	0.196* (2.61)	0.188* (2.51)	0.034 (1.11)	0.018 (0.69)	0.016 (0.60)
Population 2004	0.016* (1.99)	0.012 (1.52)	0.011 (1.42)	0.011* (2,44)	0.008+ (1.65)	0.007 (1.54)
GDP per capita 2004	-0.006* (-2.17)	-0.005+ (-1.92)	-0.004+ (-1.72)	-0.004** (-2.79)	-0.003* (-2.16)	-0.003+ (-1.94)
Number of team members 2008	0.001 (0.06)	0.004 (0.40)	0.004 (0.34)	0,012* (2,09)	0.012* (2.46)	0.012* (2.39)
Corruption perceptions index 2004		-0.358 (-1.40)	-0.306 (-1.13)		-0.292+ (-1.71)	-0.286+ (-1.66)
Former communist country			0.701 (0.55)			0.157 (0.26)
Constant	-4,051*** (-3.38)	-2.494+ (-1.79)	-2.887+ (-1.79)	-2.266*** (-4.62)	-1.112 (-1.52)	-1.173 (-1.52)
Estimated standard error of the regression (sigma)	3.231*** (4.77)	3.076*** (4.79)	3.067*** (4.79)	–	–	–
Log. dispersion parameter (ln alpha)	–	–	–	0.639 (1.20)	0.082 (0.11)	0.063 (0.08)
Observations	82	82	82	82	82	82
Mc Fadden Pseudo R^2	0.18	0.19	0.19	0.17	0.19	0.19
Correlation of predicted/actual forfeitures	0.45	0.49	0.53	0.51	0.83	0.83

t statistics in parentheses; + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. [1] Range: 0 (left-censoring limit) to 11 (right-censoring limit) medal forfeitures. The number of observations is 82 (and not 86) because of missing data for the corruption perception index.

Table II summarizes estimation results for a Tobit model,[4] which is the type of model often used in the literature on medal counts, and a count-data model (negative-binomial model). In the Tobit model, lagged medal counts and GDP per capita are significant predictors of medal forfeitures. The population variable is significant in one out of the three variants of the Tobit model that we estimated. The population variable is significant in two of the three variants of the negative-binomial model. In addition, the estimated coefficients of GDP per capita, the number of Olympic team members, and the corruption perception index are significant in the negative-binomial model. The Pseudo R^2 statistics of the models range between 0.17 and 0.19 (but should not be compared across model classes), indicating a satisfactory fit of the models.

[3] Data sources: https://www.olympic.org/beijing-2008, and http://data.worldbank.org/.

[4] Tobit models (censored regression models) are used if the dependent variable is censored. „When the dependent variable is censored, values in a certain range are all transformed to (or reported as) a single value". (Greene 2003, p. 761-780). For a discussion of whether a censored regression model is an appropriate choice for modelling Olympic medal counts, see Emrich et al. (2013).

The correlations of the predicted and actual medal forfeitures range from 0.42 (Tobit model) to 0.83 (negative-binomial model).

Although lagged medal counts are a fairly good predictor of subsequent medal counts, a natural concern is that explanatory variables like GDP per capita only predict medal forfeitures because such standard explanatory variables have predictive power for medal counts. If the athletes of a country, in turn, win many medals then the chance of a medal forfeiture increases. In order to address this concern, we conducted a robustness check. To this end, we replaced medal counts 2004 with medal counts 2008 in our list of explanatory variables. Table III summarizes estimation results for this version of our (negative-binomial) model. Medal counts 2008 and population size are a significant predictor of medal forfeitures in one out of the three variants of the negative-binomial model. GDP per capita has a significant estimated coefficient in all three versions of the model. The other explanatory variables are insignificant (where it should also be taken into account that they correlate with medal counts 2008).

Table III: Robustness Check

Model number	(1)	(2)	(3)
Model type	Negative-binomial model		
Medal counts 2008	0.089*	0.065	0.064
	(2.14)	(1.64)	(1.59)
Population 2004	0.009^{+}	0.007	0.006
	(1.90)	(1.36)	(1.33)
GDP per capita 2004	-0.004**	-0.003*	-0.003*
	(-2.79)	(-2.15)	(-2.01)
Number of team members 2008	0.006	0.007	0.007
	(1.01)	(1.28)	(1.26)
Corruption perceptions index 2004	–	-0.235	-0.234
		(-1.41)	(-1.39)
Former communist country	–	–	0.024
			(0.04)
Constant	-2.090***	-1.152	-1.160
	(-4.45)	(-1.58)	(-0.05)
Log. dispersion parameter (ln alpha)	0.395	-0.040	-0.0453
	(0.69)	(-0.05)	(-0.05)
Observations	82	82	82
Mc Fadden Pseudo R^2	0.20	0.21	0.21
Correlation of predicted/actual forfeitures	0.67	0.83	0.83

t statistics in parentheses; $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3. Concluding Remarks

Sporting institutions should be trustworthy, contribute to the values of sports, and guarantee that consumers do not turn their backs on sporting competitions because doping scandals disappoint them. Efficient sporting institutions reduce transaction costs and promote the well-being of consumers of sports in general and of athletes in sports in particular. The results we

have documented in this research note can be interpreted to show that the institutional efficiency of the international anti-doping system is improvable.[5]

The point to take home from our empirical analysis of the 2008 Olympic Summer games is that standard predictor variables (like GDP per capita) studied in research on the determinants of national medal counts at Olympic Games help to predict ex-post medal forfeitures. This predictability casts doubts that, at the national level, the institutions of the international anti-doping system work efficiently.

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[5] One dimension of institutional inefficiency is that, without a better and more efficient international coordination of anti-doping policies, sports associations and National Antidoping Agencies (NADAs) that comply with an international regulatory framework (like the World Antidoping Code) are at a disadvantage relative to sports associations and NADAs that do not comply (see Emrich and Pierdzioch 2013).